CEOTI
Clinical and Experimental
Ocular Trauma and Infection

MINI REVIEW

Received Date: 20 December 2019 Accepted Date: 25December 2019 Publication Date: 31 December 2019

Pediatric Ocular Trauma

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Introduction

Ocular trauma is the leading cause of monocular blindness in children.(1) 2.4 million eye injuries occur in the United States per year, with 35% of injuries in patients 17 years of age or less.(2) Every year, 160,000 to 280,000 children under the age of 15 require admission for ocular trauma.(3) Pediatric ocular trauma presents numerous complications over that in adults, representing a major concern for ophthalmologists. Delays in presentation, incomplete history, decreased cooperation during exams, and inaccurate visual acuity measurements may severely hinder an ophthalmologist's ability to correctly diagnose and manage pediatric ocular trauma.(4) The overall occurrence of pediatric ocular trauma has decreased by 17% from 1990-2009, in part due to implementation of eye protection for children.(5) However, there have been increases in the amount of ocular trauma associated with specific activities, namely firearm injuries. Since ocular trauma is a significant cause of childhood blindness worldwide, awareness and preventative measures are imperative to decrease this preventable loss of vision.

Etiology of Pediatric Ocular Trauma

Common causes of pediatric ocular injuries include blunt and penetrating trauma secondary to traffic accidents and projectile injury.(4) Blunt trauma is the most common form of ocular trauma in pediatric cases, while 21-24% of cases are penetrating globe injuries.(3) The etiology of pediatric ocular trauma depends greatly on the age at presentation, mostly due to activities performed at various developmental stages. Ocular trauma is more common in children 9 years old or younger. The most common mechanism of injury is self-inflicted poking of the child's eye with a sharp object or trauma secondary to objects thrown at children.(6) In older children, there is an increased risk of sports-related injury, whereas younger children have a predisposition for injuries related to falling, household cleaners, desk supplies, and toys.(3) The most common location of injury is in the home, possibly due to decreased supervision in comparison to school and childcare environments.(6) There is a distinct male predominance of ocular trauma, with 65% of all eye injuries occurring in male patients, and males have a higher annual mean injury rate compared to females.(5)

Certain high-risk activities have been associated with increased risk of ocular trauma and deserve mention to increase awareness and preventative strategies. Increased exposure to firearms has led to a significant increase in firearm related ocular injuries in the pediatric

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population. From 2008 to 2014, 25% of all firearm-related ocular injuries occurred in pediatric patients, most commonly males ranging from 12-18 years old. These injuries occurred either in the home or outdoors. The most common form of ocular injury was open globe, followed by ocular adnexal injury, orbital injury, orbital fractures, and contusion of the eye.(7) Risk factors for ocular injury from firearms include absence of supervising adult, recreational gun use, large numbers of individuals using the weapon, and lack of safety glasses.(3)

Sports-related injuries account for about 27% of all pediatric ocular trauma requiring hospitalization, with increased incidence that correlates with an older age. The most common sporting activities resulting in ocular trauma include baseball, tennis, soccer, squash, and darts.(3)

Child abuse unfortunately remains a significant cause of pediatric ocular trauma and plays an equal role in visual impairment as accidental trauma. One of the most common examples of non-accidental head injury is shaken baby syndrome. This syndrome occurs mostly in children under 2 years old, and is characterized by retinal hemorrhages, subdural hematomas, and encephalopathy. It is imperative for healthcare professionals to recognize the unique pattern of retinal hemorrhages in order to protect the patient from further harm. Risk factors for inflicted injury include unknown paternal identity, low socioeconomic status, male sex, low birth weight, and medical co-morbidities.(3)

Diagnosis

Children presenting with ocular trauma have a more complex clinical course than adults, largely due to delays in presentation, unclear mechanism of injury, and inability to cooperate with the ophthalmic exam. These factors make the initial assessment of pediatric ocular trauma difficult and less accurate, resulting in delays in triage and appropriate management. Therefore, it is imperative for ophthalmologists to obtain comprehensive history and exam and supplement with appropriate diagnostic testing.(4) Taking a complete history is crucial for initial assessment, and certain injuries should be suspected based upon the history. For instance, the potential presence of an intraocular foreign body must be considered with history of explosion, gunshot wound, or sharp object entering the eye.

Once a comprehensive history is obtained, the patient should undergo thorough ophthalmic exam. Ocular exam includes obtaining visual acuity, assessing for afferent pupillary defect, delineating confrontational visual fields, and determining degree of ocular motility. Slit lamp examination of the conjunctiva, sclera, cornea, anterior chamber, iris, angle and lens is performed to determine potential violation of the globe and identify any intraocular foreign body. Pediatric patients who are unable to cooperate with the exam often require examination under anesthesia to assess the severity of trauma and intervene immediately in cases of penetrating injury. An examination under anesthesia becomes even more critical in cases with history and initial ophthalmic assessment suggestive of open globe injury. Open globe trauma should be suspected if the ocular exam demonstrates hemorrhagic chemosis, intraocular pressure of <10mmHg, abnormally deep or shallow anterior chamber, or peaked pupil. Occult open globe injury may rarely present with nonspecific conjunctival injection and irritation.(8)

Diagnostic imaging may be conducted to further assess the presence of an intraocular foreign body and evaluate the extent of globe damage. The most common forms of imaging include CT scan and B-scan ultrasonography. CT scan has been shown to be 95% sensitive for intraocular foreign body detection, although it exposes patients to increased doses of radiation. B-scan ultrasonography is a rapid, cost-effective method for diagnosing retinal detachment and intraocular foreign body and may be chosen over CT scan due to decreased exposure to radiation. X-ray may be used to detect metallic foreign bodies and orbital fractures, and has advantages due to the rapidity, widespread availability, and low cost of testing. MRI is less commonly used for nonmetallic intraocular foreign bodies, usually in cases when CT scan is unable to differentiate hypodense foreign bodies from air. (8) MRI may require general anesthesia in younger patients.

Management

Management of pediatric ocular trauma depends greatly on the mechanism of injury and the extent of globe damage. In cases of open globe injury, a rigid eye shield should be placed over the injured eye for immediate protection. Studies have also shown that administration of prophylactic broad-spectrum antibiotics decreases the risk of endophthalmitis. Analgesics and anti-emetics may also be administered for patient comfort and prevent emesis that may cause transient increase in intraocular pressure and risk uveal prolapse. Patients are ad-

vised to rest with limited activity until surgical repair.(8) The primary goal of surgical management in ocular trauma is to close penetrating wounds, reposition any prolapsed ocular contents, remove foreign bodies, and treat complications associated with injury in order to preserve final visual acuity.(8)

Prognosis after pediatric ocular trauma depends on a variety of factors, including presenting visual acuity, location of wound, presence of afferent pupillary defect, mechanism of injury, retinal detachment, and endophthalmitis.(9) Scoring systems have been developed to assist in triaging globe injury and predicting outcomes after appropriate management. Scoring systems further allow for efficient communication between emergency department physicians and consulting ophthalmologists. The ocular trauma score (OTS) has been validated in populations worldwide and is commonly used to predict final visual acuity and overall prognosis. The scoring system is based on four presenting characteristics of the ocular injury: type of injury, grade of injury, pupil, and zone of injury. Type of injury is defined by mechanism of injury. Studies have shown that blunt force injury results in ocular rupture and carries a poor prognosis compared to penetrating ocular injury which is associated with localized eye wall injury. Grade of injury is defined by the visual acuity in the injured eye on presentation. Pupil is defined by presence of relative afferent pupillary defect in the injured eye. Afferent pupillary defect is a gross measure of retinal and nerve function, and presence of the defect equates to significant damage to either structure. Grade and pupil have been shown as the most significant predictors of visual outcome. Lastly, zone of injury is defined by the relative anteroposterior extent of the injury. Injuries that are more posterior carry worse prognosis as there is a higher risk of involvement of the optic nerve and retina. In such cases, despite anatomic correction, post-operative visual acuity may remain limited.(9)

Although such scoring systems have assisted with triaging and determining prognosis of ocular injury in adults, certain criteria within the scoring system are notably hard to obtain in pediatric patients, including presenting visual acuity and relative afferent pupillary defect. Therefore, a pediatric ocular trauma score (POTS) was developed that includes variables such as age and location of injury to allow for accurate scoring without visual acuity and afferent pupillary defect. A retrospective study by Awidi and Kraus suggests that POTS may be superior to OTS in predicting final visual acuity in the pediatric population.(4)

Complications

Pediatric patients are predisposed to certain complications over adults after management of ocular trauma, leading to significant reduction in visual acuity. The most common causes of loss of visual acuity in pediatric patients after ocular trauma are amblyopia, difficulty in follow-up examinations, effect of management, and outcome of perforating ocular injury.(6) Factors that contribute to loss of visual acuity after ocular trauma include young age at presentation, poor initial visual acuity, posterior location of injury, wound size, lens involvement, vitreous hemorrhage, retinal detachment, and endophthalmitis.(4)

Amblyopia is the most common cause of reduced visual acuity after pediatric ocular trauma.(4) Amblyopia occurs due to the length of visual rehabilitation and therapy after open globe repair in children. Patients should undergo aggressive prevention of amblyopia with patching as a gold standard.

Endophthalmitis is a severe complication of open globe injury associated with significantly worse visual acuity. The incidence of endophthalmitis is higher in children, 4.9-54.2%, compared to 0.9-18.4% in adults. Risk factors for development of endophthalmitis include intraocular foreign body, injury in rural setting, wound contamination with organic matter, delay in primary wound closure greater than 24 hours, and involvement of the lens capsule. Streptococcus is the most commonly isolated organism in pediatric patients, likely translocated from normal skin flora. Prophylactic antibiotics and aggressive management are critical in preventing endophthalmitis in the pediatric population.(8)

Other common complications associated with globe injury in the pediatric population are retinal detachment and vitreous hemorrhage. Retinal detachment is associated with a worse visual prognosis. Pars plana vitrectomy with silicone oil infusion has been shown to be more effective in the pediatric population as it provides a clear view without requiring face-down post-operative positions in comparison to gas tamponade, leading to greater compliance. Vitreous hemorrhage is often seen with posterior segment injuries and may present 2-3 weeks after initial injury. Although observation is the primary management of vitreous hemorrhage in a great majority

of cases, this should be balanced with the risk of developing amblyopia rapidly in young patients.(8)

Conclusion

Ocular trauma remains the leading cause of monocular blindness in children. Blindness has been shown to have a significant impact in the pediatric population, as children who have experienced loss of vision score lower on quality-of-life questionnaires than their peers.(7) Pediatric ocular trauma is further associated with certain complications, including amblyopia and endophthalmitis, that significantly impact prognosis of visual outcome. These aspects highlight the need for increased awareness and prevention strategies to mitigate vision loss in the pediatric population. Education of caretakers and children, accessibility to eye protection, and decreased exposure to certain high-risk activities may serve to significantly decrease the incidence of pediatric ocular trauma.

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